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FACULTY OF ENGINEERING & TECHNOLOGY

Electrical Machine-1

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Determination of losses by Swinburne's test

This method is an indirect method of testing a DC machine. Swinburne's test is the most commonly used and simplest method of testing of shunt and compound wound DC machines which have constant flux. In this test the efficiency of the machine at any load is pre-determined. We can run the machine as a motor or as a generator. In this method of testing no load losses are measured separately and eventually we can determine the efficiency.

Calculation of Efficiency

Let, I_0 is the no load current (it can be measured by ammeter A_1)

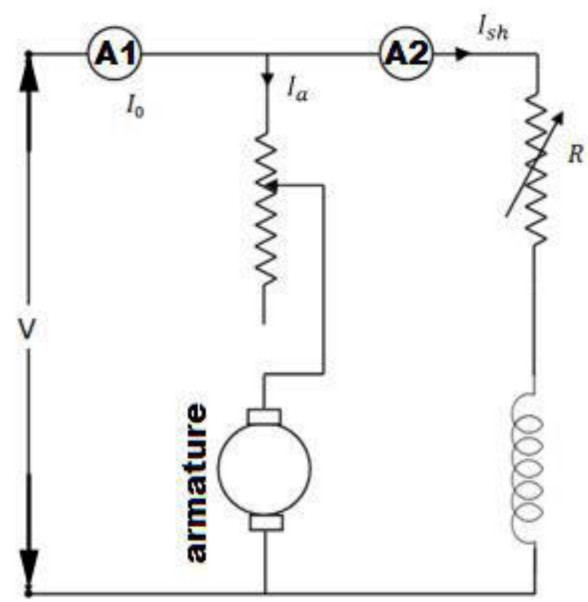
I_{sh} is the shunt field current (it can be measured by ammeter A_2)

Then no load armature current = $(I_0 - I_{sh})$

Also let, V is the supply voltage. Therefore, No load power input = VI_0 watts.

In **Swinburne's test** no load power input is only required to supply the losses. The losses occur in the machine mainly are:

- Iron losses in the core
- Friction and windings losses
- Armature copper loss.



Since the no load mechanical output of the machine is zero in Swinburne's test, the no load input power is only used to supply the losses.
The value of armature copper loss = $(I_0 - I_{sh})^2 R_a$

Here, R_a is the armature resistance.
Now, no to get the constant losses we have to subtract the armature copper loss from the no load power input.
Then,

$$Constant\ losses\ W_C = VI_0 - (I_0 - I_{sh})^2 R_a$$

After calculating the no load constant losses now we can determine the efficiency at any load.

Let, I is the load current at which we have to calculate the efficiency of the machine.

Then, armature current (I_a) will be ($I - I_{sh}$), when the machine is motoring.

And $I_a = (I + I_{sh})$, when the machine is generating.

Calculation of Efficiency When the Machine is Motoring on Load

Power input = VI
Armature copper loss, $P_{CU} = I^2 R_a = (I - I_{sh})^2 R_a$

Constant losses, $W_C = VI_0 - (I_0 - I_{sh})^2 R_a$

$$Total\ losses = P_{CU} + W_C$$

∴ Efficiency of the motor: $$\eta_m = \frac{output}{input} = \frac{input - losses}{input} = \frac{VI - (P_CU + W_C)}{VI}$$

Calculation of Efficiency When the Machine is Generating on Load

Power input = VI

Armature copper loss, $P_{CU} = I_2 R_a = (I + I_{sh})^2 R_a$

Constant losses, $W_C = VI_0 - (I_0 - I_{sh})^2 R_a$

$$Total\ losses = P_{CU} + W_C$$

∴ Efficiency of the generator:

$$\eta_g = \frac{output}{input} = \frac{input - losses}{input} = \frac{VI - (P_CU + W_C)}{VI}$$